Deindustrialization and Changes in Manufacturing Trade: Factor Content Calculations for 1978–1995

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Abstract: Input-output analysis is used to estimate the labor content embodied in changes in manufacturing output resulting from changing patterns of manufacturing trade. For ten OECD countries from the late 1970s to the mid-1990s, changes in world trade of manufactures are estimated to have had a negative net effect on manufacturing employment of 3.5 million jobs, 2.0 million in the US alone, compared to a 6.2 million decline in actual manufacturing employment. The employment losses resulted mainly from North-South trade. At the industry level, there were large losses in labor-intensive industries and in industries that were strategically targeted by developing country industrial policies. There were employment losses in nearly all manufacturing industries, not a mixture of winners and losers. Such a pattern may result not from surging imports from the South but rather declining exports to the South in the aftermath of the 1980s debt crisis. JEL no. F14, F16, O24
Keywords: International trade; deindustrialization; factor content analysis

1 Introduction

The long-standing academic debate over the role of developing country trade in the deindustrialization of the developed world was rekindled in the 1990s as developing country exports to OECD markets reached historic highs. On one side of the debate were those who claimed the relative unimportance of North-South trade for industrial country manufacturing employment (Krugman 1996; Krugman and Lawrence 1996;

Remark: We are grateful to Anwar Shaikh, Duncan Foley and especially to an anonymous referee for comments on an earlier draft. Please address correspondence to William Milberg, Department of Economics, New School University, 65 Fifth Avenue, New York, NY 10003, USA; e-mail: milbergw@newschool.edu

Rowthorn and Ramaswamy 1999). On the other side were those who claimed that North-South trade contributed substantially to developed country deindustrialization (Sachs and Shatz 1994; Wood 1994, 1995; Saeger 1997). In this paper we use input-output analysis to estimate the labor content embodied in changes in manufacturing output (final demand plus intermediate goods) resulting from changing patterns of manufacturing trade – that is, we assess the role of manufacturing trade in deindustrialization. Evaluated are ten OECD countries, the G7 plus Australia, Denmark and the Netherlands, from the late 1970s to the mid-1990s. We find that for these ten countries, changes in world trade of manufactures are estimated to have had a negative net effect on manufacturing employment of 3.5 million jobs, 2.0 million of these in the US alone, compared to a 6.2 million decline in actual manufacturing employment for these ten countries over the period (OECD 1999).

Breaking up the sources of these employment losses between North-North and North-South trade reveals that they are driven almost exclusively by the latter: changes in North-South trade by itself are estimated to have resulted in 3.5 million fewer manufacturing jobs over the period. Changes in North-North trade are estimated to have resulted in a net loss of only 20,000 manufacturing jobs for these ten countries, with six of the ten countries estimated to gain employment from North-North trade and with Canada, Denmark, and the Netherlands the biggest gainers relative to late 1970s manufacturing employment. For North-South trade, in contrast, all ten countries are estimated to have lost manufacturing employment from changing trade patterns.

As we enter the final years of the implementation of the 1994 Uruguay Round Agreement, with many of its tariff reductions back-ended for the 2002–2004 period (for example in textiles and apparel) imports from developing countries are likely to rise further. While these changing trade patterns are a positive development for many developing countries, resulting manufacturing job losses in developed countries could be an important policy issue, especially if this period of trade liberalization coincides with a global slowdown in economic growth. At the same time, it is worth emphasizing that we evaluate the effects of manufacturing trade on manufacturing employment, not the effects of trade on the economy as a whole. The policy issue therefore is not so much job loss as such but rather job reallocation from manufacturing to other sectors of the economy. The case of the US is telling in this regard, for while changes in world trade are estimated to have resulted in 2.0 million fewer

manufacturing jobs, with North-South trade accounting for 1.3 million of these, the US economy as a whole gained nearly 25 million jobs over this same period (OECD 1999).

One of the benefits of using input-output analysis to evaluate the effects of trade is that it yields industry-level results which are particularly useful in providing insights into the causes of manufacturing employment losses resulting from North-South trade. We identify three factors contributing to these losses. First, consistent with standard trade theory and prior factor content studies, there are disproportionate employment losses in labor-intensive industries, particularly in textiles, apparel, leather and leather goods, which account for 1.1 million of the 3.5 million in employment losses estimated to result from North-South trade expansion for our group of ten countries.

Second, large losses are estimated in industries that are not comparatively labor-intensive but that have been targeted by industrial policies in a number of industrializing countries of the South. These industries produce electronic equipment (including consumer electronics and computers) and motor vehicles.

Third, we find estimated employment losses in 20 of 22 manufacturing industries as a result of changing patterns of North-South trade. This differs from the findings of an earlier round of factor content studies, described by Wood (1991: 22) as follows: "All the studies have identified the same sets of winning and losing sectors. The losers include food processing, wood products, textiles and clothing, and leather goods and footwear. These losses have been largely offset, however, by increased employment in the machinery and chemicals industries." This picture – of distinct lists of "winners" and "losers" – is at odds with the findings of this study that industries differ mainly in the extent to which they suffered manufacturing job losses relative to the benchmark scenario. This suggests the importance of factors that cut across industries. We observe, for example, that while the ten developed OECD countries in the sample had a fairly steady increase in imports from non-OECD countries over the period, they also exhibited a sharp decline in exports to the South in the first half of the 1980s, when a number of developing countries experienced slow or negative growth as a result of their debt crises.

This paper contains five sections. Section 2 gives an overview of trade expansion with the North and South for our group of countries, comparing patterns of import penetration as well as volumes of

trade with the South relative to volumes of world trade. Section 3 describes the method of factor content results and then country-level results in the context of actual changes in manufacturing and total employment. Section 4 provides industry-level results, and Section 5 concludes.

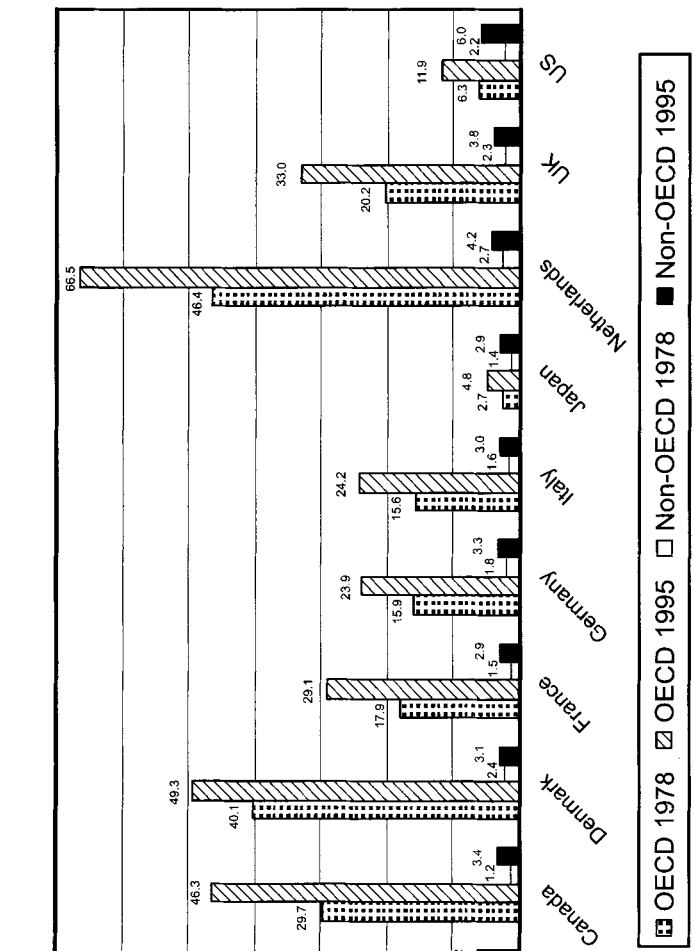
2 Comparing OECD and Non-OECD Trade Expansion

This study makes use of OECD *Bilateral Trade Database* (1998a) in which the trade between our ten countries and the OECD and non-OECD regions are based on pre-1990s OECD membership. That is, the newer members of the OECD (the Czech Republic, Hungary, Poland, Mexico and South Korea) are included in the non-OECD region. Thus the trade between the ten countries in our study and the OECD and non-OECD regions provide an approximation of North-North and North-South trade, respectively, and hereafter we refer to the trade with the OECD and non-OECD regions accordingly.

Import penetration is a commonly used measure of the presence of foreign goods in domestic markets, and is defined as the ratio of manufacturing imports to domestic consumption (domestic production plus net imports) of manufactures. Figure 1 shows OECD and non-OECD import penetration for the ten countries in 1978 and 1995. The ten countries have three things in common regarding these measures. All had higher OECD than non-OECD import penetration in both 1978 and 1995; in terms of growth indicated by percent changes, import penetration increased more for non-OECD than OECD trade in all ten countries; in terms of percentage point differences, however, in absolute terms import penetration increased more for OECD than non-OECD trade in all ten countries. The levels of non-OECD import penetration are relatively low and their variance small, ranging from 2.9 percent for France and Japan to 6.2 percent for Australia in 1995. OECD import penetration ranges much more widely, from 4.8 percent for Japan to 66.5 percent for the Netherlands in 1995.

Import penetration is not a measure of trade performance, as it is essentially one-sided. It is worth mentioning in this regard that the three countries with the highest OECD import penetration, Canada, Denmark and the Netherlands, also had the largest increases over the period in the ratio of OECD manufacturing exports to imports (and

Figure 1: *OECD and Non-OECD Import Penetration for Manufactures, 1978 and 1995*



Note: For 1978, Germany refers to the former Western Germany; for 1995, trade data (but not output data) includes regions of the former East Germany.

Source: OECD (1998b, 1998a).

indeed are estimated to gain the most in terms of relative manufacturing employment from changes in OECD trade of manufactures).[1] From the viewpoint of OECD countries, however, non-OECD import penetration has a different significance than OECD import penetration as regards employment effects from trade expansion. This is because trade between OECD and non-OECD countries is characterized by greater differences in the labor intensity of production than intra-OECD trade and in particular that exports from non-OECD to OECD countries are generally more labor-intensive than exports from OECD to non-OECD countries. As such, even if increased imports from non-OECD countries are balanced by increased exports to non-OECD countries, the differences in the labor intensity of trade will result in manufacturing employment losses. Wood emphasizes this point in explaining his and Sachs and Shatz's (1994) estimates of losses in manufacturing employment resulting from North-South trade expansion. He writes:

> The fundamental reason for this outcome is that the goods imported by developed countries are more labor intensive than those they export: it would occur even if trade were balanced and thus does not depend on the existence of a trade deficit, which is often portrayed as the culprit in the US. (Wood 1995: 66)

An additional sense of the relative importance of OECD versus non-OECD trade is provided by Figure 2, which shows non-OECD manufacturing trade (exports plus imports) as a percent of world manufacturing trade in 1970–1995 for the ten countries in our study taken together. The measure never exceeds 30 percent over the period and does not show a strong overall increase. There has been a stronger increase in more recent years, however, with the measure increasing from 23 to 29 percent from 1990 to 1995. This suggests that it is useful to follow up on earlier factor content studies, particularly Sachs and Shatz (1994) and Wood (1994), both of which evaluate the period up to 1990.

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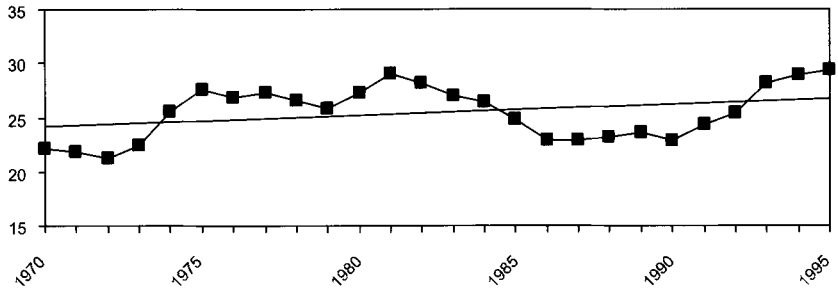
[1] From the late 1970s to the mid-1990s, the ratio of OECD manufacturing exports to imports increased from 0.90 to 1.04 for Canada, 0.80 to 1.13 for Denmark and 1.03 to 1.15 for the Netherlands (OECD 1998a). The only other country in the sample with a comparable increase was Germany, for which the measure increased from 1.28 to 1.39. These ratios are based on three-year endpoint averages for the identical span of years evaluated with factor content analysis, as noted below.

Figure 2: *Non-OECD Manufacturing Trade as a Percent of World Manufacturing Trade, 10 Country Total, 1970–1995*



Source: OECD (1998a).

3 Factor Content Calculations and Country-Level Results

Our estimates of the effects of changes in manufacturing trade on manufacturing employment are based on similar factor content calculations as used by Sachs and Shatz (1994).[2] The input-output model is defined as

$$\mathbf{L} = \hat{E}\,[(\mathbf{I} - \mathbf{A})^{-1}\mathbf{T}], \tag{1}$$

where

$\mathbf{L}$ = the vector of changes in manufacturing employment associated with the changing structure of manufacturing trade,

$\hat{E}$ = the diagonal matrix of labor coefficients (employment per unit of output),

[2] Our estimates differ in that we define final demand as domestic production for final demand plus imports rather than, as Sachs and Shatz (1994: 27) do, domestic production for final demand plus *net* imports. Generally speaking, these different definitions of final demand yield very similar results. However, there are cases (for instance, rubber and plastic products and fabricated metal products in Italy) where final demand as defined by Sachs and Shatz yields negative values, in that exports exceed the sum of domestic production for final demand and imports, leading to wildly inaccurate estimates of the effects of trade on employment. Very similar results are also obtained by using either domestic production or final demand in the construction of the trade expansion vector. See Wood (1994: 72) for a discussion of the relative merits of using domestic production or final demand (value added) in the calculation of the trade expansion vector. Wood concludes that "there is no single best way to do the calculations."

$\mathbf{I}$ = the identity matrix,

$\mathbf{A}$ = the technical coefficients matrix, and

$\mathbf{T}$ = the trade expansion vector. $\mathbf{T}$ is defined as:

$$\mathbf{T} = (\mathbf{X}^{95} - \mathbf{M}^{95}) - (\mathbf{X}^{78} - \mathbf{M}^{78})(\mathbf{D}^{95}/\mathbf{D}^{78}), \tag{2}$$

where

$\mathbf{X}, \mathbf{M}$ = vectors of export and import values, respectively, and

$\mathbf{D}$ = vector of final demand, that is, domestic production for final demand plus imports. $\mathbf{D}$ is thus defined as

$$\mathbf{D} = [(\mathbf{I} - \mathbf{A})\mathbf{Q}] + \mathbf{M}, \tag{3}$$

where $\mathbf{Q}$ = domestic production.

Put in words, $\mathbf{T}$ is defined for each industry as the difference between actual net exports at the end of the period and a counterfactual level of net exports that would have resulted at the end of the period had the ratio of net exports to final demand remained constant over the period – that is, had trade propensities relative to final demand remained constant. When $\mathbf{T}$ is used as the measure of final demand in the input-output model, therefore, $\mathbf{L}$ provides an estimate of how trade has changed manufacturing employment from what it would have been had the structure of trade remained unchanged, with the input-output model accounting for the effects of $\mathbf{T}$ on $\mathbf{L}$ through demand for both final and intermediate outputs. $\mathbf{T}$ is constructed separately for world trade (OECD plus non-OECD) and non-OECD trade. This yields $\mathbf{L}$ for both world and non-OECD trade, with $\mathbf{L}$ for OECD trade defined as the difference between the two.

This study makes use of the OECD's *STAN Structural Analysis* databases, which have the advantage of having trade, input-output, production, employment and price data largely standardized across 22 manufacturing industries. The ten countries in our study are those for which input-output data are available in these datasets. Input-output data are for 1990 for seven of the ten countries, differing for Australia (1989), Italy (1985) and the Netherlands (1986). All values are converted to real terms for the year of the input-output data and labor coefficients are also for the same year. Regarding the superscripts in (2), endpoints are calculated as three-year averages, to smooth out point-to-point volatility. Thus "78" refers to the average for 1978–1980 and "95" refers to the average for 1993–1995. For some countries, data do not run to 1993–1995,

Table 1: *Country-Level Manufacturing Employment Effects from Trade of Manufactures*

	Number of employees in worker years	Relative to 1978–80 mfg. emp. (%)		Number of employees in worker years	Relative to 1978–80 mfg. emp. (%)
Australia (1978–92)			Japan (1978–95)		
World Trade	−85 730	−6.95	World Trade	−941 391	−6.78
OECD Trade	−44 105	−3.58	OECD Trade	−345 861	−2.49
Non-OECD Trade	−41 625	−3.37	Non-OECD Trade	−595 530	−4.29
Canada (1978–95)			Netherlands (1978–95)		
World Trade	129 658	7.10	World Trade	187 327	18.18
OECD Trade	329 819	18.06	OECD Trade	280 588	27.23
Non-OECD Trade	−200 160	−10.96	Non-OECD Trade	−93 261	−9.05
Denmark (1978–94)			United Kingdom (1978–94)		
World Trade	92 321	18.60	World Trade	−659 902	−9.04
OECD Trade	114 570	23.08	OECD Trade	−152 434	−2.09
Non-OECD Trade	−22 249	−4.48	Non-OECD Trade	−507 467	−6.95
France (1978–95)			United States (1978–95)		
World Trade	−109 230	−1.99	World Trade	−2 021 256	−9.85
OECD Trade	112 818	2.06	OECD Trade	−768 626	−3.75
Non-OECD Trade	−222 048	−4.05	Non-OECD Trade	−1 252 630	−6.10
Germany (1978–90)			10 country total		
World Trade	−76 193	−0.85	World Trade	−3 543 549	−5.32
OECD Trade	370 268	4.11	OECD Trade	−19 560	−0.03
Non-OECD Trade	−446 461	−4.96	Non-OECD Trade	−3 523 989	−5.29
Italy (1978–94)					
World Trade	−59 155	−1.01			
OECD Trade	83 403	1.42			
Non-OECD Trade	−142 558	−2.42			

Source: OECD (1998b, 1998a, 1995).

as is indicated in the span of years following country headings in Table 1. Throughout this study, Germany refers exclusively to the former West Germany or the regions of the former West Germany, except as noted in Figure 1.

Country-level results are shown in Table 1 both in absolute terms, i.e., by the number of manufacturing employees in worker years, and in relative terms, i.e., by the number of manufacturing employees as a percentage of 1978–1980 manufacturing employment. Ten-country totals are shown at the bottom right of the table, indicating that employment in manufacturing would have been 3.5 million worker years higher if the trade structure had stayed the same over the period. This result is driven by 3.5 million in estimated losses from non-OECD trade and with OECD trade estimated to result in a net loss of 20,000 jobs compared to

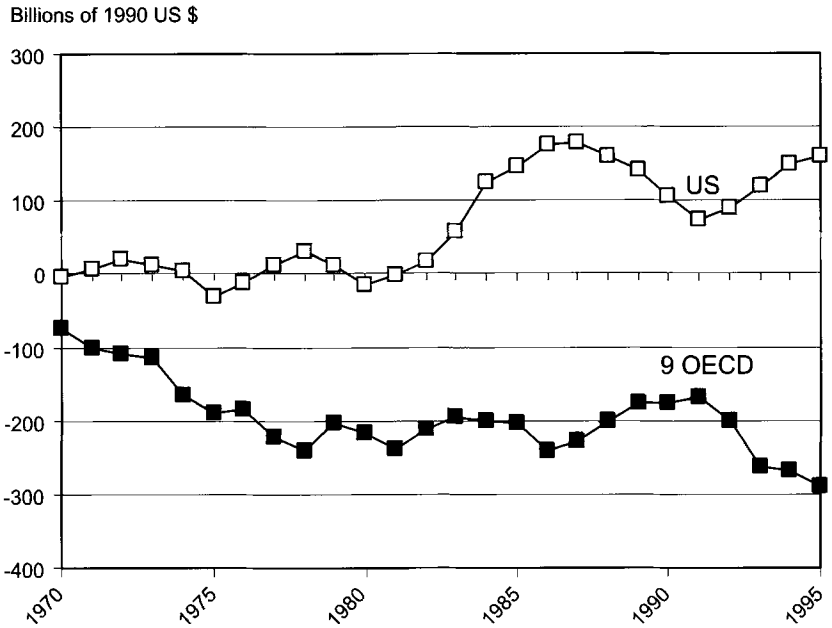
the counterfactual. The 3.5 million in lower employment is equivalent to 5.3 percent of manufacturing employment for the ten countries in 1978–1980. Looking at individual countries, three of ten countries are estimated to gain from world trade and six of ten from OECD trade. Each of our ten countries is estimated to lose manufacturing employment from non-OECD trade of manufactures.

The US has far and away the largest estimated absolute manufacturing employment losses compared to the other nine countries for world, OECD and non-OECD trade, with figures of 2.0 million, 0.8 million, and 1.3 million, respectively. These large absolute losses are consistent with patterns of net imports for world trade of manufactures, shown in Figure 3, comparing the US with the aggregate of the other nine countries in the study. The US ran a trade deficit in manufactures for every year after 1981 and showed a trend increase in net imports over the 1978–1995 period. The other nine countries ran trade *surpluses* in manufactures over the entire 1970–1995 period, peaking in 1995. The pattern of net imports for the US and the other nine countries is particularly divergent from 1990 to 1995, when the measure increased strongly for the US and decreased even more strongly for the other nine countries taken together.

The figure of 1.3 million for the US in the case of non-OECD trade is equivalent to 6.1 percent of 1978–1980 manufacturing employment, just slightly higher than the estimate by Sachs and Shatz for the US of 5.7 percent of 1978 manufacturing employment resulting from developing country trade expansion between 1978 and 1990 (Sachs and Shatz 1994: 29). Our results for world trade of manufactures nevertheless do differ substantially from Sachs and Shatz's as a result of considerably different estimates for OECD trade. Sachs and Shatz estimate that expansion of world trade of manufactures led to a loss of 1.2 million manufacturing jobs (compared to our figure of 2.0 million) with nearly all of this resulting from trade with developing countries. Much of the difference between our and Sachs and Shatz's estimates appears to result from our inclusion of the 1990–1995 period, when the US manufacturing trade deficit increased by 76.4 billion (constant 1990) US dollars, with 44.7 billion of this accounted for by OECD trade.[3] Although the rapid increase in the US manufacturing trade deficit in the 1990s con-

[3] In addition, Sachs and Shatz (1994: 10) use somewhat different definitions of North and South than we do. For instance, they include Spain and Portugal in the group of

Figure 3: *Net Imports of Manufactures for the US and the Aggregate of 9 Other OECD Countries, 1970–1995*



Source: OECD (1998a).

tributed to the estimated manufacturing job loss, it is arguable that this deficit was driven by the comparatively rapid growth of the US economy during these years and reflects, in this sense, economic success rather than failure.

Next after the US, Japan is the country with the largest estimated absolute manufacturing employment losses for world, OECD and non-OECD trade, with figures of 0.9 million, 0.3 million, and 0.6 million, respectively. These figures might seem surprising given Japan's well-known export success, but of all countries in the sample Japan in fact had the largest *decline* in its ratio of exports to imports for both world and OECD trade in manufactures.[4]

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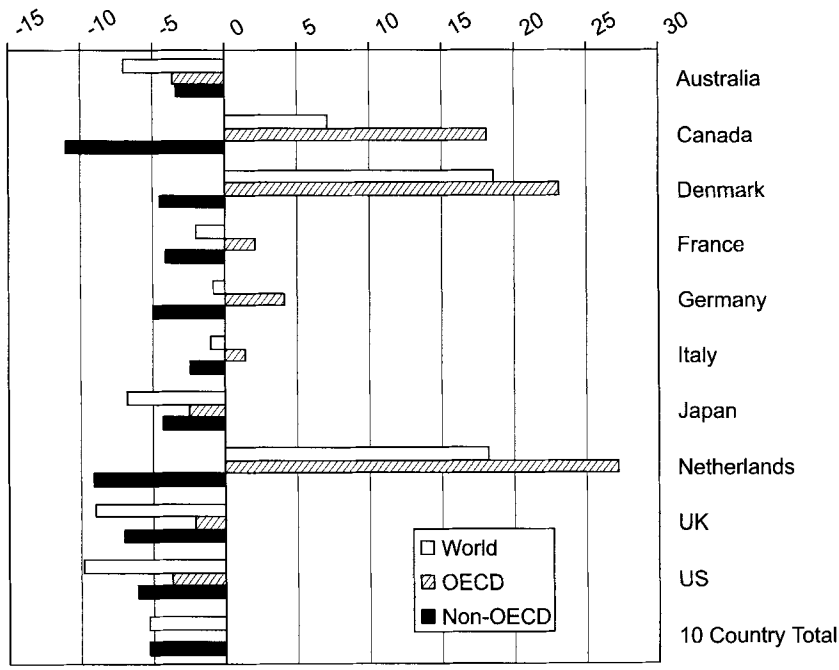
developing countries and the former Czechoslovakia and East Germany in the group of developed countries.

[4] Japan's export-import ratios for world trade declined from 2.43 to 1.97 and for OECD trade from 2.00 to 1.84 from 1978 to 1995, based on three-year endpoint averages (OECD 1998a).

The US and Japan also had the largest absolute number of manufacturing employees of the ten countries, and for the purposes of cross-country comparison it is more useful to consider estimated employment changes in relative terms, that is in terms of overall manufacturing employment. Figure 4 shows the number of manufacturing employees as a percent of 1978–1980 manufacturing employment (the figures are also contained in Table 1). Comparing non-OECD with OECD trade effects, we see smaller variations in the former. For non-OECD trade, the measure ranges from −2.4 percent for Italy to −11.0 percent for Canada, with most countries hovering around −5 percent. For OECD trade, in contrast, the measure ranges much more widely, from −3.8 percent for the US to 27.2 percent for the Netherlands. The Netherlands, Denmark and Canada, in that order, were the largest relative gainers from OECD trade of manufactures. Accordingly, these three nations also had the

Figure 4: *Manufacturing Employment Effects from Trade of Manufactures (as a % of 1978–80 manufacturing employment)*



Source: OECD (1998b, 1998a, 1995).

largest increases in OECD manufacturing export-import ratios over the period (see Footnote 1). These are also the only three countries estimated to have gained manufacturing employment from world trade of manufactures compared to the benchmark case. In addition, Germany also had sizeable relative gains and the largest absolute gains (370,000) of our ten countries from OECD manufacturing trade expansion. The large absolute losses for the US and Japan do not appear exceptional when compared with the number of manufacturing employees as of the late 1970s.

It is useful to situate results not only relative to late 1970s manufacturing employment, but also relative to actual changes in manufacturing and total employment over the period as well as to changes in the manufacturing share of total employment. This latter is the standard indicator of "deindustrialization." Table 2 provides this data for the beginning and end of the period as well as differences and percentage changes across the period, all based on three-year endpoint averages. All countries except Japan experienced losses in manufacturing employment over the period, with net losses for the ten countries of 6.2 million.[5] This compares with the estimated 3.5 million in manufacturing employment losses from non-OECD manufacturing trade expansion for the ten countries, meaning that such trade is equivalent to over half (56.7 percent) of actual manufacturing employment losses. Note that these figures are not adjusted in any way, such as that proposed by Wood (1995) who argues that factor content calculations underestimate the negative effects of North-South trade of manufactures on manufacturing employment in the North.[6]

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[5] Rowthorn and Ramaswamy (1999: 31) suggest that the experience of Japan in this regard may result from the exceptional decline in the relative price of manufactured goods, which stimulated domestic demand for these goods.

[6] Wood has argued that employment estimates from factor content calculations such as used in Sachs and Shatz (1994) and in our study of the effects of North-South trade on manufacturing employment in the North should be roughly quadrupled (Wood: 1995). Wood argues that the estimates should be doubled based on the greater labor intensity *within* industries of "non-competing" imports from the South and then doubled again based on his estimates of the effects of trade competition on labor-displacing technical change in the traded goods sector. However, Wood's adjustments result in what seem to be improbably high estimates of the effects of North-South trade expansion on manufacturing employment losses in the North. We find, for instance, an estimated loss of 3.5 million manufacturing jobs in our ten countries as a result of non-OECD manufacturing trade expansion. Leaving aside the second adjustment, the doubled figure of 7.0 million as per Wood's first adjustment compares to

All ten countries experienced deindustrialization over the period, with particularly large percentage change declines (over 25 percent) in the manufacturing share of total employment in Australia, Canada, France, the Netherlands, the UK and the US. However, all countries also experienced increases in total employment over the period, with especially strong increases in Australia, Canada and the US, all among those countries experiencing the most rapid deindustrialization. Total employment increased for the ten countries by 41.6 million over the period. Setting the 6.2 million in manufacturing employment losses against the 41.6 million in total employment gains, it is clear that deindustrialization is driven more by increases in total employment rather than by declines in manufacturing employment. This is especially so in the cases of Australia, Canada and the US, where exceptionally rapid deindustrialization results not from exceptionally high rates of manufacturing employment loss, but rather from exceptionally high rates of total employment gain.

Precisely how much of deindustrialization is accounted for by non-OECD manufacturing trade expansion? For the ten countries, manufacturing employment as a percentage of total employment declined from 24.6 to 19.3 percent over the period, or by 5.3 percentage points. If we assume that manufacturing employment at the end of the period would have been higher by 3.5 million in the absence of changes in the structure of non-OECD trade, then manufacturing employment as a percentage of total employment would have declined by 4.1 percentage points. This means that non-OECD trade expansion is estimated to account for 21.5 percent of deindustrialization. This is similar to estimates from earlier studies of North-South trade expansion on deindustrialization in the North, based on panel data econometric models and evaluating different periods and using somewhat different definitions of North and South. For instance, Rowthorn and Ramaswamy arrive at an estimate of 20 percent, based on a sample of 18 OECD countries evaluated over the 1970–1994 period (1999). Saeger (1997) estimates that 25–30 percent of the decline in the manufacturing share of total employment in

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an actual decline in manufacturing employment of 6.2 million for these ten countries over the same period. Given that other factors are also found in other studies to contribute substantially to deindustrialization (such as shifts in the structure of demand away from manufactured goods and labor-displacing technical change not induced by trade (Saeger 1997; Rowthorn and Ramaswamy 1999)), the adjusted figure of 7.0 million appears quite high, let alone the redoubled figure of 14.0 million.

Table 2: *Changes in Employment and Deindustrialization (based on 3-year endpoint averages)*

	Beginning of period	End of period	Absolute difference	Percent change
		A. Manufacturing employment		
Australia (1978–1992)	1 233 333	1 143 333	−90 000	−7.30
Canada (1978–1995)	1 825 933	1 671 227	−154 707	−8.47
Denmark (1978–1994)	496 337	483 098	−13 239	−2.67
France (1978–1995)	5 476 900	4 055 500	−1 421 400	−25.95
Germany (1978–1990)	9 003 667	8 731 000	−272 667	−3.03
Italy (1978–1994)	5 882 033	4 684 767	−1 197 267	−20.35
Japan (1978–1995)	13 888 000	15 400 333	1 512 333	10.89
Netherlands (1978–1995)	1 030 333	894 333	−136 000	−13.20
United Kingdom (1978–1994)	7 301 000	4 981 503	−2 319 497	−31.77
United States (1978–1995)	20 521 000	18 396 667	−2 124 333	−10.35
Total	66 658 537	60 441 761	−6 216 776	−9.33
		B. Total employment		
Australia (1978–1992)	6 201 040	7 771 123	1 570 083	25.32
Canada (1978–1995)	10 719 650	13 271 164	2 551 514	23.80
Denmark (1978–1994)	2 476 923	2 539 833	62 910	2.54
France (1978–1995)	21 972 500	22 300 442	327 942	1.49
Germany (1978–1990)	26 559 333	27 799 333	1 240 000	4.67
Italy (1978–1994)	20 460 196	20 524 917	64 721	0.32
Japan (1978–1995)	54 745 847	64 536 164	9 790 317	17.88
Netherlands (1978–1995)	5 120 628	5 969 333	848 705	16.57
United Kingdom (1978–1994)	25 261 976	25 712 027	450 051	1.78
United States (1978–1995)	98 058 250	122 745 139	24 686 889	25.18
Total	271 576 344	313 169 476	41 593 132	15.32
		C. Manufacturing employment as a percent of total employment		
Australia (1978–1992)	19.89	14.71	−5.18	−26.03
Canada (1978–1995)	17.03	12.59	−4.44	−26.07
Denmark (1978–1994)	20.04	19.02	−1.02	−5.08
France (1978–1995)	24.93	18.19	−6.74	−27.04
Germany (1978–1990)	33.90	31.41	−2.49	−7.35
Italy (1978–1994)	28.75	22.82	−5.92	−20.61
Japan (1978–1995)	25.37	23.86	−1.51	−5.93
Netherlands (1978–1995)	20.12	14.98	−5.14	−25.54
United Kingdom (1978–1994)	28.90	19.37	−9.53	−32.96
United States (1978–1995)	20.93	14.99	−5.94	−28.38
Total	24.55	19.30	−5.25	−21.37

Source: OECD (1998b, 1999).

the North is accounted for by North-South trade expansion, based on a sample of up to 23 OECD countries evaluated over the 1970–1990 period.

4 Industry-Level Results

Tables 3 and 4 show industry-level results for OECD and non-OECD manufacturing trade, respectively. The industries in these tables are ranked from most to least labor-intensive, based on average ordinal rankings for the four countries for which labor coefficients are available for all 22 industries (France, Italy, Japan and the UK). The textiles, apparel, leather and leather goods sector is the most labor-intensive, and the petroleum and coal products sector the least labor-intensive.

For the ten countries taken together, 15 of 22 manufacturing industries are estimated to have lost employment as a result of changes in OECD trade relative to the counterfactual. There are four industries estimated to have gained or lost more than about 80,000 in manufacturing employment from OECD trade of manufactures. The only one of these four with estimated losses is radio, TV and communication equipment (−92,000), with losses particularly large in Japan. The estimated gains in wood products and furniture (79,000) are driven largely by Canada and Italy, and the estimated gains in fabricated metal products (94,000) were predominantly in Italy. Note that these two industries are comparatively labor-intensive. The estimated gains in paper, paper products and printing (95,000) are driven largely by France, Germany, and the UK.

For the four countries with the largest estimated gains (absolute and relative) from OECD manufacturing trade for the manufacturing sector as a whole – Canada, Denmark, Germany, and the Netherlands – we also see employment gains across a wide range of industries. The US shows employment losses across a wide range of industries. These patterns are, we have noted, consistent with changes in trade balances for these countries for the manufacturing sector as a whole.

For non-OECD manufacturing trade for the ten countries in total, there are seven manufacturing industries estimated to have lost more than about 200,000 in employment across the ten-country sample as a result of non-OECD trade expansion. Far and away the most important of these is textiles, apparel, leather and leather goods, with estimated

Table 3: *Industry-Level Employment Effects from OECD Trade of Manufactures (numbers of employees in worker years, with industries ranked from most to least labor-intensive)*

	OECD STAN ISIC Rev. 2		Australia	Canada	Denmark	France	Germany	Italy	Japan	Netherlands	UK	US	10 country total
1	32	Textiles, apparel, leather & leather goods	15 109	14 480	13 112	−1 640	30 980	50 159	−85 500	50 890	−34 300	−67 800	−14 510
2	33	Wood products & furniture	−7 701	24 433	18 103	8 918	14 725	43 715	−23 260	12 939	−3 082	−9 750	79 090
3	381	Fabricated metal products	−3 121	14 238	12 259	10 630	38 720	81 720	−36 780	26 453	−20 090	−30 250	93 779
4	385	Professional goods & precision instruments	−3 389	−355	2 744	6 172	31 893	1 030	−9 606	8 048	250	−24 880	11 906
5	355 + 356	Rubber & plastic products	−1 333	24 522	5 407	6 730	14 788	−85 290	−13 450	9 984	−17 330	6 530	−49 442
6	383 − 3832	Electrical equipment, other	194	−8 580	6 723	11 968	12 050	11 257	5 720	41 590	−25 580	−56 760	−1 418
7	382 − 3825	Non-electrical machinery	−1 856	19 407	15 430	6 960	49 884	24 454	47 060	29 867	−48 920	−174 620	−32 334
8	3842 + 3844 + 3849	Other transport	na	na	na	−3 250	na	2 857	−29 780	na	−2 180	na	−32 353
9	36	Non-metallic mineral products	827	3 595	3 145	4 254	9 755	2 457	−11 893	6 810	−7 299	−16 610	−4 959
10	39	Jewelry, musical instruments, toys & sporting goods, misc	4 973	4 475	993	9 276	18 432	5 897	−4 146	7 968	−19 379	−36 940	−8 451
11	34	Paper, paper products & printing	4 328	−13 506	7 617	24 068	31 296	4 556	−5 480	14 237	22 556	5 040	94 712
12	3841	Shipbuilding & repairing	4 040	559	2 417	211	767	1 606	−8 477	2 265	8 494	−7 104	4 778
13	3832	Radio, TV & communication equipment	−5 910	31 003	3 038	15 319	na	−9 546	−145 030	na	25 300	−6 240	−92 066
14	3522	Drugs & medicines	−3 384	−2 228	3 366	−2 216	na	−7 751	570	−2 289	−1 559	−8 678	−24 169
15	3845	Aircraft	−10 843	30 920	na	14 940	5 057	2 265	10 317	4 942	19 558	−42 704	34 453
16	3825	Office & computing machinery	na	17 154	na	−923	−9 200	−2 250	54 610	15 206	15 755	−105 700	−15 348
17	3843	Motor vehicles	−1 445	142 250	4 559	−40 260	40 231	−31 950	−49 040	15 141	−39 280	−70 370	−30 164
18	371	Iron & steel	−690	15 819	17	4 251	23 230	8 875	−5 828	11 820	−8 140	−69 460	−20 107
19	31	Food, beverages & tobacco	−18 310	1 232	6 357	23 369	12 819	6 596	−19 040	22 819	1 327	26 930	64 099
20	351 + 352 − 3522	Industrial chemicals	−4 787	2 892	8 737	11 138	35 767	−24 140	230	3 059	−8 980	−48 700	−24 783
21	372	Non-ferrous metals	−9 753	6 714	−528	4 136	8 600	4 057	−16 580	na	−10 651	−28 020	−42 025
22	353 + 354	Petroleum & coal products	−1 054	796	1 074	−1 234	424	−7 171	−478	−1 160	1 096	−2 540	−10 247
		Manufacturing total	−44 105	329 819	114 570	112 818	370 268	83 403	−345 861	280 588	−152 434	−768 626	−19 560

Note: "na" indicates data not available; shaded rows indicate industries with roughly 80 000 or more in estimated employment gains or losses.

Source: OECD (1998b, 1998a, 1995).

employment losses of 1.1 million.[7] Employment losses in this industry are estimated to be particularly high in Japan and the US. Italy is the only country estimated to gain employment from non-OECD trade expansion in textiles, apparel, leather and leather goods, not surprising given the country's well-known competitive success in the industry. Employment losses are also estimated to be high in other comparatively labor-intensive industries, particularly in fabricated metal products (−295,000), rubber and plastic products (−220,000) and electrical equipment, other (−329,000). Each of our ten countries is estimated to have lost employment in these three industries as a result of non-OECD manufacturing trade expansion, with particularly large losses across these industries in France, Germany, Japan, the UK and the US. These findings are consistent with standard trade theory based on the comparative advantage of developing countries in the production of labor-intensive goods.

Employment losses are also estimated to be large in industries that are not comparatively labor-intensive, including radio, TV and communication equipment (−198,000), office and computing machinery (−215,000), and motor vehicles (−212,000). With the exception of motor vehicles for the Netherlands, each of our ten countries is estimated to lose employment in each of these three industries from non-OECD trade. Losses across the three industries are estimated to be particularly large in Canada, France, Germany (though data on radio, TV and communication equipment are missing), Japan, the UK and the US. These findings are consistent with the well documented export successes in these industries of a number of developing countries, especially East Asian countries. These export successes depended not only on the forces of comparative advantage but also on targeted industrial policies aimed at improving international competitiveness.[8]

There are estimated employment losses in 20 of 22 manufacturing industries, with the aircraft and petroleum and coal products industries the only exceptions. Moreover, estimated employment gains in these two industries are relatively small, summing to only 60,000. In contrast to the scenario found in earlier factor content studies of some winning

[7] An earlier study finds that the "gender bias" of the manufacturing employment effects of North-South trade, with women estimated to experience disproportionate employment losses, results from the effects of trade in this (labor-intensive and female-intensive) industry (Kucera and Milberg 2000).

[8] See Lee (1995) for a careful study of South Korea in this regard.

Table 4: *Industry-Level Employment Effects from Non-OECD Trade of Manufactures (numbers of employees in worker years, with industries ranked from most to least labor-intensive)*

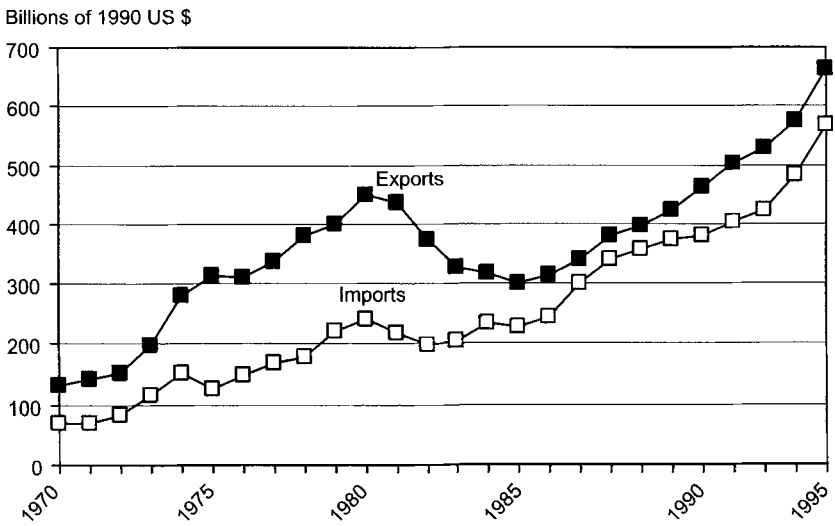
	OECD STAN	ISIC Rev. 2	Australia	Canada	Denmark	France	Germany	Italy	Japan	Netherlands	UK	US	10 country total
1	32	Textiles, apparel, leather & leather goods	−1 209	−41 930	−6 427	−54 910	−45 100	3 831	−278 900	−25 100	−109 200	−562 600	−1 121 545
2	33	Wood products & furniture	−393	−2 943	−1 013	−480	−7 640	805	−40 610	−2 379	−4 671	−26 630	−85 954
3	381	Fabricated metal products	−2 253	−11 980	−3 008	−32 310	−50 760	−12 990	−91 920	−6 143	−30 750	−52 970	−295 084
4	385	Professional goods & precision instruments	−1 298	−5 737	−525	−9 537	−1 213	−1 959	10 520	−726	−11 980	−15 710	−38 165
5	355 + 356	Rubber & plastic products	−2 958	−8 462	−1 219	−23 570	−19 410	−30 710	−32 840	−2 864	−32 440	−65 520	−219 993
6	383 − 3832	Electrical equipment, other	−3 003	−13 520	−601	−21 110	−82 740	−10 250	−42 210	−26 300	−45 060	−83 840	−328 634
7	382 − 3825	Non-electrical machinery	−1 961	−8 827	−4 500	−18 970	−58 300	−5 144	23 780	−4 197	−54 180	−29 180	−161 479
8	3842 + 3844 + 3849	Other transport	na	na	na	−3 184	na	−1 128	−3 320	na	−9 110	na	−16 742
9	36	Non-metallic mineral products	−1 185	−3 176	−351	−3 534	−5 786	−9 153	−5 997	−1 712	−9 171	−20 630	−60 695
10	39	Jewelry, musical instruments, toys & sporting goods, misc	−5 411	−7 028	−497	−5 730	−8 172	−4 721	−3 775	−3 592	−4 121	−83 660	−126 707
11	34	Paper, paper products & printing	−3 160	3 366	−392	−8 128	−9 046	−8 061	−16 590	−1 257	−21 270	−18 620	−83 158
12	3841	Shipbuilding & repairing	−1 763	−1 032	−991	−438	681	2 362	3 750	−224	−4 525	2 071	−109
13	3832	Radio, TV & communication equipment	−11 890	−27 970	−1 163	−9 546	na	−3 554	−36 370	na	−57 170	−50 270	−197 933
14	3522	Drugs & medicines	−133	−708	−363	−890	na	−3 939	822	971	−8 412	−4 682	−17 334
15	3845	Aircraft	−367	−1 900	na	22 330	918	−2 818	233	478	−10 390	39 370	47 853
16	3825	Office & computing machinery	na	−16 790	na	−9 367	−11 720	−19 360	−10 600	−8 931	−17 100	−125 600	−215 478
17	3843	Motor vehicles	−1 581	−28 050	−47	−25 410	−35 910	−4 890	−23 100	3 229	−41 180	−54 930	−211 869
18	371	Iron & steel	−2 526	−8 875	−347	−10 680	−58 870	−8 825	35	−6 918	−13 630	−38 740	−149 376
19	31	Food, beverages & tobacco	−11 520	−2 562	150	3 751	−3 461	3 464	−31 850	−119	7 467	10 640	−24 040
20	351 + 352 − 3522	Industrial chemicals	−133	−6 832	−851	−5 659	−36 240	−26 590	3 651	−8 076	−21 630	−58 400	−160 761
21	372	Non-ferrous metals	1 475	−4 928	−185	−4 523	−14 010	−2 702	−20 190	na	−8 629	−14 850	−68 542
22	353 + 354	Petroleum & coal products	9 644	−277	82	−152	318	−226	−49	608	−315	2 121	11 754
		Manufacturing total	−41 625	−200 160	−22 249	−222 048	−446 461	−142 558	−595 530	−93 261	−507 467	−1 252 630	−3 523 989

Note: "na" indicates data not available; shaded rows indicate industries with roughly 200 000 or more in estimated employment losses.

Source: OECD (1998a, 1998b, 1995).

and some losing industries (Wood 1991), we observe employment losses across the full range of manufacturing industries. This suggests the importance of broader, perhaps macroeconomic factors. Illustrative in this regard are the patterns of non-OECD manufacturing exports and imports for the ten countries taken together, shown in Figure 5. Note that exports exceeded imports over the entire 1970–1995 period. Thus the estimated manufacturing employment losses occurred at the same time that these countries ran a surplus in manufactures trade. The surplus does narrow over the period, however, and this results from the export rather than import side. That is, for imports from non-OECD countries, we see a fairly steady overall increase. Exports from our ten countries to non-OECD countries most often moved in parallel to imports. Whenever non-OECD imports were rising rapidly – for example during the early 1970s and the 1990s – exports were growing at a similar rate. The exceptional period is the first half of the 1980s, when imports were flat but exports dropped very substantially in the wake of the early 1980s debt crisis, during which a number of developing countries experienced deep recessions. Evidence indicates that the pattern of cross-industry employment losses results not from surging imports from non-OECD

Figure 5: *Non-OECD Manufacturing Exports and Imports of 10 Country Total, 1970–1995*



Source: OECD (1998a).

countries but rather from a large drop in exports to non-OECD countries. This suggests that slow economic growth in developing countries contributed to deindustrialization in richer countries.[9]

5 Conclusion

We use input-output analysis to estimate changes in manufacturing employment resulting from the changing structure of manufacturing trade, evaluating ten OECD countries over the period from the late 1970s to the mid-1990s. Employment losses from world trade of manufactures are driven by North-South trade and are equivalent to over one-half of the actual 6.2 million decline in manufacturing employment for our ten countries over the period. In this sense, manufacturing trade expansion is estimated to have contributed very substantially to deindustrialization. Moreover, all of our ten countries are estimated to have lost manufacturing employment as a result of expanding trade with the South. In contrast, North-North manufacturing trade expansion is estimated to have had only negligible effects on manufacturing employment for our ten countries taken together, with losses in some countries offset by gains in others. If we define deindustrialization as the decline in the manufacturing share of total employment, we find that North-South manufacturing trade expansion is estimated to account for just over one-fifth of the 5.3 percentage point decline in this measure for our ten countries taken together. This is similar to estimates from other studies (Saeger 1997; Rowthorn and Ramaswamy 1999).

The industry-level results reveal three factors contributing to manufacturing employment losses in our ten countries as a result of North-South trade of manufactures. First, there are large losses in labor-intensive industries, particularly textiles, apparel, leather and leather goods. Second, there are large losses in industries producing electronic equipment and motor vehicles, industries that were strategically targeted by developing-country industrial policies. Third, rather than a scenario of winning and losing industries, we find employment losses in 20 of 22 manufacturing industries. This result is contrary to the popular view that trade has resulted in winning and losing sectors in Northern manufactures. This pattern of across-the-board employment losses from trade

[9] A similar argument is found in UNCTAD (1995).

with the South is not the result of surging imports from low-wage developing countries, but from the decline in exports to these markets in the aftermath of their debt crises in the 1980s. This suggests the importance of situating the debates on North-South trade and deindustrialization in a broader macroeconomic context.

The macroeconomic context is relevant in several other ways. Defining deindustrialization as the decline in manufacturing employment relative to total employment, for instance, we see this is driven considerably more by the 41.6 increase in total employment than the 6.2 million decrease in manufacturing employment for our ten countries over the period. It was also noted that for three of the countries experiencing the most rapid deindustrialization – Australia, Canada and the US – this resulted from comparatively rapid increases in total employment rather than comparatively rapid decreases in manufacturing employment.

There is another sense in which the macroeconomic context is relevant to these debates. Public concern with the deindustrializing effects of trade, so prominent in the 1980s and early 1990s, largely died out in the late 1990s. This was certainly not due to a slowdown in imports from developing countries to developed country markets during this period. On the contrary, developing countries attained an acceleration of import penetration. But this occurred during the long period of economic expansion in the 1990s and especially the impressive growth of employment in the US. During periods of more rapid aggregate demand (and wage) growth in developed countries, low-wage import competition is hardly noticed. It is when aggregate demand growth is slow that low-wage competition from abroad becomes central to policy debates in industrialized countries.[10] Today, with economic growth having slowed in the US and other industrialized countries, the issue of trade and deindustrialization may return to the center of policy discussions.

Appendix: Data Notes

This study makes use OECD's *STAN Structural Analysis* databases, the *Input-Output Database* (1995) for input-output data, the *Bilateral Trade Database* (1998a) for trade data, and the *STAN Database for Industrial Analysis* (1998b) for output, total employment, and price deflator data (the last derived from

[10] See UNCTAD (1995) for some evidence on this point.

data on value added in real and nominal terms). These datasets have the advantage of being largely standardized by industry classification, following what the OECD calls an "Adjusted ISIC Revision 2 Classification," for which there are 22 distinct manufacturing industries.

The OECD *Input-Output Database* provides data only for the ten countries considered in this paper. Input-output data for the most recent year available are used. For Australia, Denmark, Germany, and the Netherlands, input-output data do not perfectly conform to the "Adjusted ISIC Revision 2 Classification." Thus data from the *STAN Database for Industrial Analysis* and *Bilateral Trade Database* are modified to match the input-output data for these countries whenever feasible. For Australia, ISIC 3832 also includes ISIC 3825; for Denmark, ISIC 382 – 3825 also includes ISIC 3825 and ISIC 3843 also includes 3842 + 44 + 49 and 3845 (where "–" indicates "minus," not "through"); for Germany, ISIC 351 + 352 also includes ISIC 3522 and ISIC 383 – 3832 also includes ISIC 3832 (ISIC 3842 + 44 + 49 is omitted, as input-output data for it is spread among industries in such a way that a correction is not feasible); for the Netherlands, ISIC 371 also includes ISIC 372 and ISIC 383 – 3832 also includes ISIC 3832.

Regarding the definition of the OECD and non-OECD regions in the *Bilateral Trade Database*, the data documentation states: "The relatively new OECD member countries (Czech Republic, Hungary, South Korea, Mexico, and Poland) are currently included in the Non-OECD" region.

Whenever possible, the analysis uses data from 1978 to 1995. As a result of missing employment and production data, however, the analysis runs only to 1992 for Australia and 1994 for Denmark, Italy, and the UK. For Germany (that is, the former West Germany), trade data include regions of the former East Germany after 1990, and thus the analysis runs only to 1990. In addition, employment data in Australia for ISIC 3845 run begin in only 1981; employment data in Japan for ISIC 3842 + 44 + 49 and ISIC 3825 begin in only 1984. Thus other data for these industries in these two countries is also truncated to match the shorter period. Employment and production data for ISIC 3842 + 44 + 49 are missing for all years for Australia, Canada, Denmark, the Netherlands, and the US; employment and production data for ISIC 3845 are missing for all years for Denmark. These industries in these countries are thus excluded from the analysis.

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